that it was safe to proceed. The Louisville & Nashville Railroad suspended trains early in the day and the New Orleans & Northeastern Railroad suspended all trains crossing Lake Pontchartrain early in the afternoon. As a precautionary measure, women and children working in the department stores and factories were, on the advice of the Weather Bureau, sent to their homes early in the afternoon.

The center of the storm moved inland somewhere near and east of Gulfport, Miss., and New Orleans, being on the rim of the hurricane, did not experience high winds. The maximum wind velocity at New Orleans during the hurricane was 35 miles per hour from the northwest, at 4:03 p. m. The wind direction was from the northeast from midnight until 8 a. m., north from 8 a. m., until 12 noon, northwest until 10 p. m., then west at 11 p. m., and southwest at midnight. Light misting rain fell most of the day. The barometer fell steadily but slowly from noon, July 4, the rate of fall increasing after midnight to about 0.15 inch an hour and continuing at that rate until 5:15 p. m. of the 5th, when the sea-level pressure was 29.41 inches, which is the lowest pressure recorded at New Orleans for any July.

At Burrwood the wind reached storm velocities about 1 a. m., July 5; verifying velocities occurred at frequent intervals during the early morning, and at 9 a. m. the wind increased to a gale, with maximum velocities during the hours ending at 9 a. m., 58; 10 a. m., 60; 11 a. m., 63; 12 noon, 62; 1 p. m., 60; 2 p. m., 58; 3 p. m., 56; 4 p. m., 49; 5 p. m., 46; and 6 p. m., 37. After 6 p. m. the wind gradually subsided. On account of trouble with the wireless apparatus at Burrwood we were unable to communicate with that station after 7 p. m., July 4. All persons at Burrwood, including the observer, went aboard the dredge *New Orleans* as a precautionary measure, and no barometer readings were taken at Burrwood between 2:30 a. m., July 5, and 2 p. m., July 5, when the barometer was rising again.

TABLE 1.—*Barometer readings at Burrwood, La.*

Date.	Time.	Barometer.	Wind direction.	Date.	Time.	Barometer.	Wind direction.
1916.	P. M.	*Inches.*		1916.	P. M.	*Inches.*	
July 4.....	12:45	29.77	ne.	July 4.....	8:30	29.65	n.
	1:15	29.78	ne.		9:30	29.63	n.
	1:45	29.77	ne.		11:30	29.59	n.
	2:15	29.74	ne.				
	2:45	29.72	ne.		A. M.		
	3:15	29.71	ne.	July 5.....	12:30	29.53	n.
	4:00	29.69	ne.		1:00	29.50	n.
	4:30	29.69	ne.		2:00	29.47	n.
	5:30	29.67	ne.		2:30	29.43	n.
	6:00	29.66	n.				
	6:30	29.65	n.		P. M.		
	7:00	29.65	n.		2:00	29.38	sw.

There was neither lightning nor thunder at Burrwood. The tide was 2.2 feet above the normal.

White Harbor.—The following report has been furnished this office by Prof. Flonan Schaffter from White Harbor (near Gulfport), Miss.:

On July 5 at 7 a. m. the tide was unusually high, the barometer was 29.55 inches, and the wind northeast; the barometer readings were as follows: 8 a. m., 29.46; 11 a. m., 29.40; noon, 29.32; 12:50 p. m., 29.22; 1:50 p. m., 29.13; 2 p. m., 29.10, and wind shifting to the north; 2:05 p. m., 29.02; 4:10 p. m., 28.88; 5 p. m., 28.85, the lowest barometer reading during the storm, and the wind shifting from north to northwest; 8:20 p. m., 29 inches; July 6, 12:45 a. m., 29.38, wind west to southwest; 7 a. m., 29.64.

Pass Christian, Miss.—Dr. A. R. Robertson, Pass Christian, Miss., has furnished the following record of observations made during the passage of the hurricane:

TABLE 2.—*Record of pressure and wind at Pass Christian, Miss., July 5, 1916.*

Date.	Time.	Barometer.	Wind direction.	Date.	Time.	Barometer.	Wind direction.
1916.	A. M.	*Inches.*		1916.	P. M.	*Inches.*	
July 5.....	8:00	29.65	ne.	July 5.....	3:30	29.12	n to nw.
	9:00	29.60	ne.		3:45	29.10	n to nw.
	10:30	29.52	n to ne.		4:00	29.08	nw.
	NOON.	29.42	n to ne.		4:15	29.06	nw.
					4:30	29.04	nw.
	P. M.				4:45	29.03	nw.
	12:15	29.40	n to ne.		5:00	29.03	nw.
	12:30	29.38	n to ne.		5:15	29.03	nw.
	12:45	29.38	n to ne.		5:30	29.04	w to nw.
	1:00	29.36	n.		5:45	29.03	nw.
	1:15	29.36	n.		6:00	29.04	w to nw.
	1:30	29.34	n.		6:15	29.04	w to nw.
	1:45	29.32	n.		6:30	29.05	w to nw.
	2:00	29.28	n.		7:00	29.10	(1)
	2:15	29.26	n.		8:30	29.16	(1)
	2:30	29.23	n.		9:00	29.20	(1)
	2:45	29.19	n.		10:00	29.28	(1)
	3:00	29.16	n to nw.		11:45	29.44	w.
	3:15	29.13	n to nw.				

[1] Wind backing to the west.

SOUTH CAROLINA HURRICANE OF JULY 13–14, 1916.

By J. H. SCOTT, Meteorologist.

[Dated Weather Bureau Office, Charleston, S. C., July 22, 1916.]

The hurricane that struck the South Carolina coast on July 13, 1916, and whose center passed inland during the early hours of the 14th was remarkable in a number of particulars. It was of unusual severity, though its path of destructiveness was comparatively narrow. Few, if any, of the usual premonitory signs were present. No unusual cloud formation or movement was observed locally in advance of the storm and even during the afternoon of the 13th, when fresh to strong gales were blowing, it was a subject of remark that the cloud movement appeared sluggish. The tides preceding the storm were only slightly above the predicted heights—a condition that invariably obtains during the prevalence of easterly winds, which had been blowing for a day or two. Variation of the tide from the predicted height at the customhouse dock, as obtained from United States Assistant Engineer Allen, was as follows: Low tide, about midnight 12th–13th, normal; high tide, morning of 13th, +0.8 foot; low tide, midday 13th, +1.3 feet; high tide, evening of 13th, +2.3 feet (actual height 8.5 feet, which was the highest during the hurricane); low tide, due $0^h\ 57^m$ a. m. of the 14th, +0.9 foot, occurred about 2 hours and 45 minutes after the predicted time because of westerly winds. High tide morning of the 14th was +0.5 foot.

The sky presented no unusual appearance at sunrise and sunset preceding or during the storm. The first indication of the advance of the hurricane was the abnormal pressure fall along the South Atlantic coast during the 12 hours ending at 8 a. m. of the 13th. Special observations were sent at 11 a. m., 2 p. m., and 4 p. m. on telegraphic orders, and another at 12:28 p. m. in accordance with existing instructions. Orders to hoist northeast storm warnings at 12:30 p. m. were received at 12:45 p. m. and orders to hoist hurricane warnings at 7 p. m. were received at that hour. Both received immediate attention. The hurricane warnings were distributed widely, though owing to a number of adverse circumstances it was not possible to carry out the prearranged plan in full.

Effort to communicate with McClellanville by telephone failed owing to the prostrated lines; and W. A.

King, of Mount Pleasant, who had agreed in advance to carry the warnings, upon being called upon to perform the service stated that it was utterly impossible for any person to make the trip that night on account of the fallen timber. He had been up that way in the afternoon and had great difficulty in returning. All efforts to induce a courier to go to Yonges Island met similar defeat. The warnings reached Martins Point by telephone, however, and were distributed widely over that section. Telegraph offices were closed, and upon notification that delivery was impossible before morning telegrams to several places were ordered canceled. Unavailing effort was made to reach Georgetown by telephone, but the telegraphed warnings reached that place.

In this city every available means was used for the distribution of the warnings, including rockets, fire bells, an electric advertising sign, the telephone, printed bulletins distributed by messenger, moving-picture screens, etc. Tugs that had promised, for a compensation, to distribute hurricane warnings and assist people from the islands to reach the city had already sought places of safety for themselves, and their masters could not be communicated with by telephone. A. R. W. Stoesen, messenger boy, was sent in search of them with instructions to get the lighthouse tender *Cypress* if they were not at their wharves. This he did in the raging storm, running nearly a mile to her dock on Ashley River. Capt. J. P. Johnson, of the *Cypress*, prepared at once to go to Sullivans Island, and safely transported to the city all who would come. Warnings had previously been disseminated there, and the cooperation of the military authorities at the Army post had been secured in collecting the people in places of safety. About 125 returned on the *Cypress* and large numbers spent the night in the fort. The regular trolley and ferry service to Mount Pleasant and the islands had been discontinued with the 5 o'clock p. m. trip from the city, the poles bearing the trolley wires from Mount Pleasant to Sullivans Island having gone down.

From Georgetown the tug *E. T. Williams* was sent to Waverly Mills up the Waccamaw River, and a courier walked about 3 miles across to warn the residents of Pawleys Island and Murrels Inlet. The telephone line to South Island was down; no vessel would undertake the trip to North Island or South Island, and no one would attempt the trip overland, so these stations did not receive the hurricane warnings, though the northeast storm warnings were displayed. There is no inclination to censure those who refused to attempt overland trips through wooded sections, for the undertaking would have been perilous in the extreme and probably impossible of accomplishment.

At Charleston during the forenoon of the 13th there was a gradual fall in the barometer with moderate to fresh northeast winds. Rain began to fall at 12:11 p. m. and became heavy at 12:17 p. m., coincident with a sudden increase in the wind, which reached a velocity of 47 miles per hour about 12:20 p. m. Northeast storm warnings were ordered by the local official at 12:15 p. m. and were hoisted at 12:20 p. m. The rain ended at 12:32 p. m. and the wind subsided, but another heavy shower began at 12:58 p. m. with increasing wind and a velocity of 52 miles was attained shortly before 2 p. m. The wind again diminished and was below a 36-mile velocity for nearly an hour, but began to increase about 3:30 p. m., reaching 58 miles before 4 p. m., and 64 miles about 4:35 p. m. This was the highest velocity recorded from the northeast, but the wind held steadily in that quarter until about 10 p. m., when it began to shift to north, and by 2 a. m. of the 14th was becoming northwest, reaching the highest velocity from that direction, 64 miles, shortly after 2 a. m. The extreme velocity was 76 miles from the northwest at 2:08 a. m. It is reasonably certain that the velocity at this time was the highest during the storm, being considerably higher than during the preceding afternoon, but owing to the position of the instruments on the eastern waterfront, with the city to the west and northwest, the difference is not indicated in the record.

The wind then diminished very slowly, notwithstanding the fact that the barometer continued to fall until 4 a. m., when it reached the lowest point, 29.02 inches, reduced. Velocities of 50 miles or above were maintained until 6 a. m., and by about 11 a. m. the wind had fallen to 36 miles per hour, though it exceeded that velocity occasionally thereafter. The wind began to

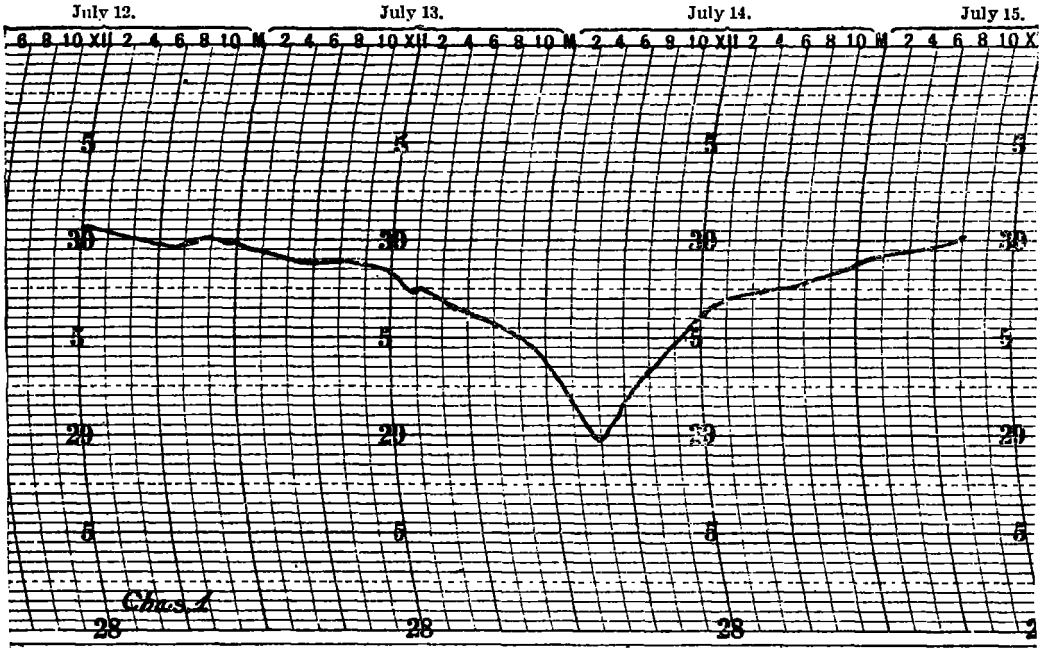

FIG. 1.—Barogram at Charleston, S. C., July 13-14, 1916. (Sea-level pressure and 75th mer. time.)

shift to west about 4 a. m. and to southwest between 5 and 6 a. m., continuing from that direction until about 2 p. m., when it became south. It was fortunate for Charleston and the adjacent islands that the wind shifted from easterly to westerly directions before the time of high tide on the morning of the 14th, thus preventing a disastrous inundation.

The fall in the barometer increased during the afternoon of the 13th and became more rapid after 10 p. m., when the reading was 29.54 inches. From 12:30 a. m. to 5 a. m. of the 14th readings were made at half-hour intervals and were as follows: 12:30 a. m., 29.32; 1 a. m., 29.28; 1:30 a. m., 29.22; 2 a. m., 29.12; 2:30 a. m., 29.08; 3 a. m., 29.05; 3:30 a. m., 29.03; 4 a. m., 29.02; 4:30 a. m., 29.09; 5 a. m., 29.13. The rise after 4 a. m. was steady; at 8 a. m. the reading was 29.40, at noon 29.68, at 4 p. m. 29.75, and at 8 p. m. 29.84.

The displayman at Georgetown reports readings as follows: 7 p. m. of the 13th, 29.52; 9 p. m., 29.50; midnight, 29.38; 3 a. m., 14th, 29. The readings are not carried further, and it is not stated what barometer was used, though it is stated that it reads 0.16 inch too low.

Following the heavy showers at the beginning of the storm, the rain during the afternoon of the 13th was not heavy and ceased at 5:15 p. m. It began again at 7:40 p. m. and continued steadily throughout the storm period, the total amount of precipitation in connection with the storm being 4.33 inches.

The material damage locally was not great. Most houses suffered minor damage to roofs and consequent water damage. Some signs were blown down and a few valuable plate-glass windows were broken. No large vessels suffered material injury, though a number of small boats were sunk at their wharves, and a few of them were crushed, though most of them suffered only minor damage. The telephone system was badly deranged, 1,500 phones being placed out of commission. Wire communication with the outside world was practically cut off, but was restored within a few hours, though service has been extremely poor ever since the storm, due partly, no doubt, to the flood situation. One of the most lamentable results of the storm from a community point of view was the damage to shade trees, the soaking rain and the shifting winds combining to uproot many of them. There were two lives lost in Charleston and vicinity, one negro man being electrocuted when he came in contact with a live wire, while another, who was on a gravel barge in the harbor and refused to leave it in a small boat when his companion escaped, was drowned when the barge sank. The beach resorts weathered the storm with no loss of life and no great material damage. Great credit is due Capt. Johnson of the lighthouse tender *Cypress* for making a perilous trip to Sullivans Island during the night of the 13th at the request of this office to bring back those who wished to come to the city. The *Cypress* and the tug *Wellington* of Philadelphia also performed heroic rescue work in saving all on board the naval auxiliary *Hector*, which was wrecked about 8 miles north of Cape Romain gas buoy.

The damage south of Charleston to North Edisto River seems to have been confined almost wholly to crop injury. To the northward the destruction was much greater. Large tracts of cultivated land in the McClellanville section were inundated Friday morning, causing a total loss of crops. Water stood 4 or 5 feet deep in the town and left a heavy deposit of sea sedge covering dead animals and fowls. The tide is said to have been higher than in 1893 or 1911. Energetic measures have been taken to avoid pestilence. The crop damage from about 15 or 20 miles northeast of Charleston on to McClellanville and the Santee River is estimated by those competent to judge at from 75 to 90 per cent. Almost all the trees in McClellanville were uprooted. Numerous houses were blown down, but they were mostly of flimsy construction. Loss of live stock was rather heavy from wrecking of barns, and some hogs and other small animals were drowned. Notwithstanding the great material damage there was no loss of human life.

In Georgetown the damage was apparently little worse than in Charleston, except that the tide rose higher and is said to have damaged some goods in stores on the water front, though the displayman does not mention this in his report. In fact, he states that the most serious damage was the blowing down of hundreds of shade trees and a few negro shacks. The wind at Georgetown shifted from northeast to southeast at about 2:45 a. m. The yacht *Palmetto* and a few smaller boats were sunk, but were not a total loss. The Atlantic Coast Lumber Corporation and the Winyah Lumber Co. were perhaps the heaviest individual losers, and their greatest loss is in fallen timber.

North of Georgetown the storm was less severe, though the tide was very high at Pawleys Island and Murrels Inlet. No damage of consequence occurred there, however, or at Myrtle Beach, farther up the coast.

The hurricane is believed to have been one of the most severe that has visited this coast since the Weather Bureau was established, but its destructive effects were confined to unusually narrow limits. This is due partly at least to the fact that its course was practically normal to the coast line. Its center is thought to have passed inland over Bulls Bay, about 25 miles northeast of Charleston and some 10 miles southwest of McClellanville.

The barges *Northwest* and *Southwest* broke away from the tug *Wellington*, of Philadelphia, about 9 p. m. of the 13th and grounded on the shoals off Bulls Bay about 6 miles south of Cape Romain. Each barge was manned by five men. The men from the *Northwest* drifted ashore on Sandy Point, and after facing death from hunger and thirst for nearly three days two of them swam the inlet to Cape Romain Sunday afternoon and procured the light keeper's assistance in rescuing the other three. The five men on the *Southwest* were undoubtedly lost, and the bodies of three of them have washed ashore. Aside from the two deaths previously reported in Charleston and vicinity, this appears to have been the total toll in lives taken by the storm proper, though many lives were lost in the floods resulting from its inland progress.

The two barges that have been mentioned and the U. S. S. *Hector* were apparently the only wrecks at sea.

It is practically impossible at this time to estimate with any degree of accuracy the total losses occasioned by the hurricane. The *Hector* and the two barges that were lost were together worth more than a half million dollars. The losses in Charleston and vicinity are estimated at less than $100,000, including two large fires incidental to the storm. Twenty-five thousand dollars will probably cover the losses at Georgetown. McClellanville, though much harder hit, is a smaller town and a similar amount will probably cover the losses there. This does not take into account the loss of crops and standing timber, which is hard to determine, but which, with the damage to land by salt water, will probably run into the millions. It will certainly run high into the millions if the floods which resulted from the storm's inland progress be taken into account.

In justice to the office force I wish to say that both the assistants and the messenger boy performed their full duty cheerfully without considering personal risk or comfort throughout the trying period.